

[COVID Information Commons \(CIC\) Research Lightning Talk](#)



Transcript of a Presentation by Joe Cecil (Oklahoma State University),
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[Joe Cecil CIC Database Profile](#)

Title: *A Virtual Reality simulator to train first responders involved in health care efforts related to the COVID-19 virus outbreak*

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Transcript

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Joe Cecil:

Great to be here. I'm Joe Cecil and I direct the Center for Cyber-Physical Systems at Oklahoma State University.

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My talk deals with our NSF RAPID project and before I go into details, here is going to be my outline. I'm going to stick to 10 minutes as I have to leave with some situations with my puppy. So, I'll talk about though the need and the motivation, you know, what spurred us to contact NSF for this RAPID project, then we get into - it's actually two sets of objectives, one is the the social need, and other, you know, being a NSF, they always want us to you know push the boundaries on theoretical and experimental research. And then I'll talk about the simulation modules that we've created and which we are sharing with hospitals and clinics. And then the main findings of our research before I conclude.

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Now, when COVID struck, you know, we had a lot of issues, right, with what do we tell the public about, right? One of the the major problems was there was a scarcity of nurses, you know, which we overcome but during the initial stages, we were pulling in different first responders, you know, some of them were nurses working in different sections of a hospital. And we wanted to create a cyber-based training too, which would be more effective than a traditional training where a human actually comes in, an experienced nurse sits with them and shows them the details. Obviously, you know, during the height of

the pandemic we're not too interested in physical contact. It doesn't matter what, you know, N-95 or any other kind of safety device they were using. And so we said let's go about, you know, recognizing the fact that we need a low-risk, high-effective training medium. And we also wanted it to be repeatable, right, so that if a nurse made a mistake or a nurse trainee had some issues, he or she could go back and repeat the process very quickly. So this was almost like an on-demand 24/7 type of resource.

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So, objectives - again, as I said, is twofold. One is, you know, we wanted to increase the number of first responders who could be involved in both testing as well as treatment. So for testing, you know, again most of you are probably veterans at being tested. You have the swab activities. On treatment, you know, you have to worry about: how do you hook up a ventilator to a patient. So these were our objectives. Now on the social side, the objective was, you know, apart from gleaning what I call the HCI or 'human centered computing aspects' which I'm going to talk about briefly, we also said we wanted some full-scale simulators that someone at a clinic can take and actually run with.

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So I'll make the distinction between the research and the social platforms that we created. The approach was very direct, you know, we are one of the leaders in what we call HCI research. So HCI, basically, you know, refers to if you go to - let's say a Google website or Amazon website- you see a lot of information right? The average human being with an average intellect can find out the website is pretty crappy in a few seconds or maybe a few minutes, right? So in HCI you actually look at the, you know, you work with psychologists, computer scientists, and engineers, and we look and see, you know, how the human response is in terms of cognition, comprehension, as well as, you know, other psychological aspects that you know, get involved. Now we've also adopted a participatory approach where right from the beginning we worked with the experts with the nurses and others and we were the first, you know, in the world to create what is called an information-centric process model, right?

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So I'll talk about the model later and since we don't have too much time, you know, we created this model which gave us a strong foundation so we were not guessing or interviewing with others. We developed a rigorous engineering model that explains, you know, what are the various steps, what's the various constraints, who does what, and what are the intermediate decision outcomes. And then of course, you know, we worked on the HCI attributes. We built the simulation modules using HTC Vive and HoloLens 2. We validated it and then we distributed this free of charge to hospitals.

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So this is an Elided Information-Centric Process Model. Quite a mouthful in the terminology itself and this is elided, but the overall idea is: we break down every task that has to be completed during training. So let's take, for instance, you know, the task where they have to do certain things before they do the swab, right? So the nurse washes her hands she puts on the mask, the cap, the face shield, the gown and the gloves. So we created a 3D environment where you can actually go in you can wash your hands put on the mask, the surgical cap, and you can do this without without a haptic interface. Now at each point, you know, where problems occur - there are what are called constraints, right? This is why most software companies won't tell you 50% of software products on the market actually fail, right? Because they don't follow a rigorous way and they simply come in and say oh let's code. But design is more important than coding, so we break down the constraints that need to be satisfied in each one of these tasks, and then we assign, you know, who's going to be doing this task. And then we also, you know, identify what should be the correct, you know, state of affairs once the task is completed.

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That's a little bit complicated to explain but I'm giving you another shortcut overview. Now we all know what cognition is. A formal definition is: it's a mental process to gain knowledge and comprehension. And what we are looking at is: can we tweak some of these parameters in the scene so that the nurses spend the least amount of time and are still able to be effectively trained? And our goal, again, is we want to reduce what is called a cognitive load. And each one of us has something called a working memory load, and once we go past that, only some of us can do well. You know, let's say for instance you're flying an airplane, right? A pilot who can handle higher cognitive load usually is able to avoid accidents than others, you know, with lesser cognitive load.

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So as I mentioned we have three modules during the testing. They can do pre-swab swab and pos-swab.

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And here is a pre-swab room. We have two modes, one is [with the] headset and they can watch, you know, and watch the avatar, like this nurse avatar here going through the various elements. And then we train them both with and without a cognitive load. So during training, you know, the avatar, you know, is going to be standing at the side, but they're going to pick up and here you can see the gloves and some of the caps and the gowns they can actually wear it. And then we have distractors where we heighten the cognitive load. We give them red alert black alerts, there's a number of alerts, you know. If a crazy guy is running down the corridor with a gun, there's a separate alert as well. And we go through these segments because the goal is not to fail the nurses, but we want them to gradually be able to handle difficult situations. And there are also distractions within the room, you know, you're doing a test, often some other nurse is going to barge in and then it's going to cause problems, but it's about gracefully coming to, you know, grasp the situation, and being able to respond.

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And here, you have actually a swab training process. And here, this is tricky, you know, there's been many arguments about nurses, but it looks like a large number of the swab tests in the U.S., this is anecdotal, may not have been performed very effectively. So the problem is, you know, most nurses when you go through the drive-in or anywhere else, they take the swab and they stick it up your nose. They're supposed to go in an angle of 30 degrees, which most of them get it right. The problem is, most often they do not hit the top of your nostril, right? That nasal passage. And unless you feel discomfort, then the swab is not really - have not been done perfectly. Some of them, like in my case, you know, in two of my situations, they remove the swab in three seconds. But the liquids test or, you know, the you have to hit a target of seven seconds, seven uncomfortable seconds of the swab hitting the top of your nose. That's the lower end. The higher end, you know, if you look at the NIH site, has to be 15 seconds. You know, and I went - when I went recently for surgery, there was some very thorough nurse and she stuck the swab right up my nostril and she said hang in there Joe, it's going to be 15 seconds. Ok, so we practice and then we have challenges. And, you know, nursing, this is one interesting domain. If you even get one answer wrong, they got to repeat the training by itself.

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And anyway, I'm going to skip the other details. So the assessment that we did was, first of all, we showed that you know that you can actually increase the skill levels as well as the knowledge of the testing process very well. We included distractions, you know, I won't list all of them over here: shadows over windows, so, you know, other nurses entering the room. And we concluded, we accepted the

hypothesis that, you know, distractors and interrupters do increase a person's cognitive load, which in turn, you know, negatively brings down the comprehension and knowledge acquisition.

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And we also did other tests about COVID. As to what's the best way of observing a scene. You know, there was a famous researcher by the name of Gibson, almost 50 years ago, he talked about affordance. We have proposed the notion of a dynamic affordance where it's not just the scene, you know, giving you something. But in a dynamic affordance, you can walk around, you can go in a figure of eight around the periphery, and we showed there's going to be a subtle difference, you know, and we need more research to show what's the best way to actually perceive a 3D environment.

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All right, so here's the other one - the ventilator you know has been done, but we have not validated it. And this is a little bit more complicated scenario where nurses have to hook up, you know, the ventilator to a patient who's actually, you know- it's an induced coma because most humans, we sort of push against the tube being placed in our throat, so we are pretty much knocked out for this process and we've been training nurses in this element as well.

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All right, anyway, so we talked about different elements. So we showed that one aspect that is still - we've not concluded is, there are two kinds or three kinds of virtual reality. One is the one on the upper right side, you know, where you see the nurse, you know, she's doing what is called an immersive virtual VR training. So he or she cannot see the real world all she can see is the complete virtual world, but the nurse with the red guard on the lower right end, she has a mixed reality kind of headset which means she looks at the simulator and the avatar is talking to her and guiding her, and then she's doing the actual test on the human being involved, all right?

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So anyway, we did a knowledge test and right now it's not very conclusive, but on the right side - these are a challenge test where we simulate, you know, different scenarios and we ask them to find out what's wrong you know in that swabbing procedure by itself.

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All right, so our research is continuing, you know, we've installed it in various hospitals, but our dominant partner is - there is this hospital in Prescott, Arizona. Yavapai Regional Medical Center and there are two nursing colleges in Oklahoma and because of COVID, you know, access to nurses was very difficult. So we had to pretty much go outside the system and we formed about four groups, you know, through social media in Dallas, Houston, Prescott, Stillwater and a small one in Enid.

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And I do want to acknowledge some of these, you know, these champion nurse managers. Apart from dealing with day-to-day COVID, they still sat with us they validated, they corrected us, sometimes hit us on the head to make the corrections that we had to. So one of them is Vern McKinney he's the head ER Nurse at the Prescott Center, Shiny Rustam who works at the MD Anderson Center, Heidi Ritchie, you know who's a nurse and an instructor at Northwestern Oklahoma State University Nursing School, and Dr. Nicole Hicks as well. So with that I conclude my presentation.